IN THE CLAIMS:

1. (Amended) An electronic system, comprising a single device having a light emitting portion, ~~and~~ a magnetically sensitive portion, and an energy barrier, wherein said energy barrier is between said magnetically sensitive portion and said light emitting portion, wherein said magnetically sensitive portion is capable of modulating a hot electron current flowing across said energy barrier to said light emitting portion ~~is~~ for modulating light emission from ~~the~~ said light emitting portion.

2. (Amended) An electronic system, as recited in claim 1, wherein said single device is for converting a magnetic digital signal directly into an optical digital signal.

3. (Amended) An electronic system, as recited in claim 2, wherein said ~~system~~ single device is for converting said magnetic digital signal to both an electrical digital signal and into said optical digital signal, wherein either or both of said signals can be provided as a device output.

4. An electronic system, as recited in claim 1, wherein said magnetically sensitive portion comprises a magnetically permeable material.

5. (Amended) An electronic system, as recited in claim 1, wherein said single device ~~comprises~~ includes a three-terminal light-emitting transistor, said transistor ~~comprising~~ having an emitter, a base, and a collector, wherein said light is emitted from said collector.

6. (Amended) An electronic system, as recited in claim ~~5~~ 2, ~~wherein said base comprises said magnetically sensitive portion for receiving a digital magnetic control signal,~~ wherein said magnetically sensitive portion ~~comprises~~ includes a magnetic switch, wherein switch position is determined by said ~~digital~~ magnetic digital ~~control~~ signal, wherein a first intensity of light is emitted in a first switch position and a second intensity of light is emitted in a second switch position, wherein said first intensity is greater than said second intensity.

7. (Amended) An electronic system, as recited in claim 5, wherein said transistor comprises ballistic spin filtering to spin polarize and analyze electrons ~~for operation of said switch~~.

8. (Original) An electronic system, as recited in claim 7, wherein said transistor comprises a pair of magnetically permeable layers, wherein when said magnetically permeable layers are aligned said spin polarized electrons penetrate and when anti-aligned, said spin polarized electrons are attenuated.

9. (Withdrawn) An electronic system, as recited in claim 8, wherein said magnetically permeable layers are both located in said base.

10. (Original) An electronic system, as recited in claim 8, wherein one of said pair of magnetically permeable layers is located in said base and one of said pair of magnetically permeable layers is located in said emitter.

11. (Original) An electronic system, as recited in claim 5, wherein said emitter is tunnel coupled to said base across an insulator.

12. (Amended) An electronic system, as recited in claim 5, wherein said single device ~~comprises~~ includes a buried quantum well within a semiconductor collector, wherein said quantum well is formed of a quantum well material having a lower band gap than adjacent material.

13. (Original) An electronic system, as recited in claim 12, wherein said material having a lower band gap has a direct transition for more efficient generation of light in said quantum well.

14. (Original) An electronic system, as recited in claim 12, wherein said semiconductor collector further comprises a Schottky contact region.

15. (Original) An electronic system, as recited in claim 14, wherein said semiconductor collector further comprises an n type Schottky contact region, an undoped quantum well region, and a p type substrate layer heterostructure.

16. (Amended) An electronic system, as recited in claim 12, wherein said light emitted by said single device comprises photons having an energy approximately equal to ~~the~~ said band gap of said quantum well material.

17. (Amended) An electronic system, as recited in claim 5, wherein said emitter is capable of providing ballistic electrons across said base to said collector when an emitter-base bias is provided with a potential exceeding ~~a collector-base~~ said energy barrier.

18. (Amended) An electronic system, as recited in claim 17, wherein said ~~collector-base~~ energy barrier comprises a base-collector Schottky barrier.

19. (Amended) An electronic system, as recited in claim 5, wherein said single device comprises a spin valve transistor having ~~a base-collector barrier,~~ a source for complementary carriers[[,]] and a place for recombining to generate said photons, wherein said energy barrier comprises a base-collector energy barrier.

20. (Amended) An electronic system, as recited in claim 19, wherein said ~~base-collector~~ base-collector energy barrier comprises a Schottky barrier, said source for complementary carriers comprises a p-type substrate layer, and said place for recombining comprises a quantum well.

21. (Withdrawn) An electronic system, as recited in claim 19, wherein said spin valve transistor includes a base having a first magnetically permeable layer and a second magnetically permeable layer.

22. (Withdrawn) An electronic system, as recited in claim 21, wherein said first magnetically permeable layer is ferromagnetic.

23. (Withdrawn) An electronic system, as recited in claim 21, wherein said second ~~ferromagnetic~~ magnetically permeable layer has a lower coercive field level than said first ~~ferromagnetic~~ magnetically permeable layer so said second layer can be switched without switching said first layer to provide for turning on and turning off current in said single device with an intermediate level magnetic field.

24. (Withdrawn) An electronic system, as recited in claim 23, wherein said spin valve transistor includes a base-collector contact comprising a Schottky barrier diode having a Schottky barrier height.

25. (Withdrawn) An electronic system, as recited in claim 24, wherein said Schottky barrier diode provides that only ballistic electrons having energy at least equal to said Schottky barrier height are injected into said collector.

26. (Withdrawn) An electronic system, as recited in claim 25, wherein said transistor comprises a variable emitter-base voltage and an independently variable collector-base voltage.

27. (Withdrawn) An electronic system, as recited in claim 26, wherein said transistor emits photons only when said emitter-base voltage exceeds a threshold approximately equal to ~~the~~ said Schottky barrier height.

28. (Withdrawn) An electronic system, as recited in claim 26, wherein said transistor emits photons only when said collector-base voltage exceeds a threshold approximately equal to the difference between ~~said~~ bandgap <u>of said collector</u> and said Schottky barrier height.

29. (Withdrawn) An electronic system, as recited in claim 28, further comprising a first power supply for providing an electrical potential across a collector-base junction of said transistor, wherein when said electrons are injected into said collector over a Schottky barrier with an energy at least equal to energy of said Schottky barrier, the combination of this electron energy and said potential energy provided by said first power supply provides said electrons with enough potential energy to generate photons from recombination in said quantum well.

30. (Withdrawn) An electronic system, as recited in claim 29, further comprising a second power supply for providing an electrical potential across an emitter-base junction of said transistor, wherein said emitter provides ballistic electrons at an energy exceeding said Schottky barrier when sufficient emitter-base potential is provided.

31. (Original) An electronic system, as recited in claim 5, wherein said collector comprises an n type region and a p type region and a region-there-between, wherein said region-there-between has a lower band gap than either said n type region or said p type region so as to trap both electrons and holes for facilitating recombination and photon generation.

32. (Original) An electronic system, as recited in claim 31, wherein said region-there-between is undoped or lightly doped.

33. (Withdrawn) An electronic system, as recited in claim 5, wherein emitter-base contact comprises a second ~~Schottky diode~~ energy barrier.

34. (Withdrawn) An electronic system, as recited in claim 1, wherein said single device comprises a two-terminal light-emitting transistor, said two terminal transistor comprising a base and a collector, wherein said light is emitted from said collector, wherein said base of said two terminal transistor is exposed for receiving sub-band gap photons to provide internal photo-emission of charges in said base.

35. (Withdrawn) An electronic system, as recited in claim 1, ~~further comprising~~ wherein said single device is included in a magnetic read head, wherein said single device ~~that~~ converts magnetic information into an optical signal.

36. (Withdrawn) An electronic system, as recited in claim 1, further comprising an array of said single devices for storing information and for converting said stored information into optical signals.

37. (Withdrawn) An electronic system, as recited in claim 1, wherein said single device further comprises amplification.

38. (Withdrawn) An electronic system, as recited in claim 1, further comprising a power supply, wherein said single device comprises a collector and a base, wherein said power supply is connected for providing a collector-base voltage sufficient to provide secondary electrons by impact ionization to provide amplification.

39. (Amended) An electronic system, comprising a metal base hot ~~electron metal base~~ carrier transistor having a metal base, a collector, and an energy barrier, said energy barrier between said metal base and said collector to block thermalized carriers in said metal base, said collector having a quantum well for facilitating light emission.

40. (Amended) An electronic system, as recited in claim 39, wherein said transistor comprises a pair of ferromagnetic layers wherein one of said layers can have its magnetization orientation switched independently of the other layer to facilitate magnetic switching between a first magnetic switch position and a second magnetic switch position.

41. (Amended) An electronic system, as recited in claim ~~39~~ 40, wherein a first intensity of light is emitted in ~~a~~ said first magnetic switch position and a second intensity of light is emitted in ~~a~~ said second magnetic switch position, wherein said first intensity of light is greater than said second intensity of light.

42. (Withdrawn) An electronic system, as recited in claim 39, wherein said transistor comprises ballistic spin filtering to spin polarize and analyze said ~~charges~~ carriers ~~for operation of said switch~~.

43. (Original) An electronic system, as recited in claim 39, wherein said metal base comprises a ferromagnetic layer.

44. (Withdrawn) An electronic system, as recited in claim ~~43~~ 39, wherein said metal base comprises a pair of magnetically permeable layers, wherein when said magnetically permeable layers are aligned ~~said~~ spin polarized ~~charges~~ carriers penetrate and when anti-aligned, ~~said~~ spin polarized ~~charges~~ carriers are attenuated.

45. (Withdrawn) An electronic system, as recited in claim 39, ~~further comprising~~ wherein said transistor is included in a magnetic read head, wherein said transistor ~~that~~ converts magnetic information into an optical signal.

46. (Withdrawn) An electronic system, as recited in claim 39, further comprising an array of said ~~devices~~ transistors for storing information and for converting said stored information into optical signals.

47. (Withdrawn) An electronic system, as recited in claim 39, wherein said ~~single device~~ transistor further comprises amplification.

48. (Amended) An electronic system, as recited in claim ~~39~~ 47, wherein said transistor comprises ~~a collector, a base, and~~ a power supply for providing a collector-base voltage sufficient to provide secondary electrons by impact ionization to provide said amplification.

49.-54. Cancel

55. (New) An electronic system, comprising a metal base hot carrier transistor having a metal base and a collector, an energy barrier between said metal base and said collector to block thermalized carriers, said metal base hot carrier transistor further comprising a spin filter.

56. (New) An electronic system, as recited in claim 55, wherein said spin filter comprises ballistic spin filtering to spin polarize and analyze said carriers.

57. (New) An electronic system, as recited in claim 55, wherein said spin filter comprises a ferromagnetic layer located in said metal base.

58. (New) An electronic system, as recited in claim 55, wherein said metal base comprises a pair of magnetically permeable layers, wherein when said magnetically permeable layers are aligned, carriers penetrate and when said magnetically permeable layers are anti-aligned, said carriers are attenuated.

59. (New) An electronic system, as recited in claim 55, wherein said spin filter includes a pair of ferromagnetic layers, wherein one of said ferromagnetic layers is capable of having its magnetization orientation switched independently of the other ferromagnetic layer to facilitate magnetic switching between a first magnetic switch position and a second magnetic switch position

60. (New) An electronic system, as recited in claim 59, wherein a first intensity of light is emitted in said first magnetic switch position and a second intensity of light is emitted in said second magnetic switch position, wherein said first intensity of light is greater than said second intensity of light.

61. (New) An electronic system, as recited in claim 55, wherein said transistor is included in a magnetic read head, wherein said transistor converts magnetic information into an optical signal.

62. (New) An electronic system, as recited in claim 55, further comprising an array of said transistors for storing information and for converting said stored information into optical signals.

63. (New) An electronic system, as recited in claim 55, further comprising an optical structure, wherein said optical structure is arranged to collect light emitted by said light emitting portion.

64. (New) An electronic system, as recited in claim 1, further comprising an optical structure, wherein said optical structure is arranged to collect light emitted by said light emitting portion.

65. (New) An electronic system, as recited in claim 39, further comprising an optical structure, wherein said optical structure is arranged to collect light emitted by said quantum well.

66. (New) An electronic system, as recited in claim 39, wherein said transistor further comprises amplification.

67. (New) An electronic system, as recited in claim 39, wherein said transistor comprises a power supply for providing a collector-base voltage sufficient to provide secondary electrons by impact ionization to provide said amplification.

Remarks

Claims 1-8, 10-20, 31-32, 39-41, 43, 48, and 55-67 are pending in the application. Claims 9, 21-30, 33-38, 42, and 44-47, have been withdrawn pending allowance of generic claims 1 and 39. Claims 49-54 have been canceled. Claims 1-3, 5-7, 12, 16-20, 23, 33. 35-36, 39-42, and 44-48 have been amended. New claims 55-67 have been added. The drawings have been amended as attached to correct errors in the numerals. The specification has been amended to correct minor errors identified by the Examiner and to correct other minor errors. No new matter has been added by virtue of this amendment. Reconsideration of the application as amended is requested.

Specification and Drawings

The Examiner objects to the disclosure because of informalities. The specification has been amended to fix some of the informalities identified by the Examiner. Missing numerals have also been added to FIGS. 2c and 5a (attached are marked up FIGS. 2c and 5a for review by the Examiner).

Claim Rejections--35 U.S.C. § 102

The Examiner rejects claims 1-4 under 35 U.S.C. § 102(e), as being anticipated by Nurmikko '725. However, claim 1, as amended provides:

1. An electronic system, comprising a single device having a light emitting portion, a magnetically sensitive portion, and an energy barrier, wherein said energy barrier is between said magnetically sensitive portion and said light emitting portion, wherein said magnetically sensitive portion is capable of modulating a hot electron current flowing across said energy barrier to said light emitting portion for modulating light emission from said light emitting portion.

Nurimikko does not teach or suggest a single device with an energy barrier between the magnetically sensitive portion and the light emitting portion that is capable of modulating a hot electron current flowing across the energy barrier to the light emitting portion for modulating light emission. Nurimikko has diffusive and drift current flow, not hot electron flow over an energy barrier. His diffusive and drift current flow requires the opposite of an energy barrier. Current flow would be cut off with his drift and diffusion device were an energy barrier added to Nurimikko. Therefore, the rejection of claim 1 and claims dependent thereon as anticipated by Nurimikko under 35 U.S.C. § 102(e) has been traversed.

The Examiner rejects claims 1-8, 10, 17-20, 39-41, 43, and 48 under 35 U.S.C. § 102(b), as being anticipated by Kamiguchi '353.

As to claim 1 and claims dependent thereon, Kamiguchi does not teach or suggest a single device with an energy barrier between the magnetically sensitive portion and the light emitting portion that is capable of modulating a hot electron current flowing across the energy barrier to the light emitting portion for modulating light emission. Kamiguchi has diffusive and drift current flow, not hot electron flow over an energy barrier. His diffusive and drift current flow requires the opposite of an energy barrier. Current flow would be cut off with his drift and diffusion device were there an energy barrier. Therefore, the rejection of claim 1 and claims dependent thereon as anticipated by Kamiguchi under 35 U.S.C. § 102(e) has been traversed.

Claim 39, as amended provides:

39. An electronic system, comprising a metal base hot carrier transistor having a metal base, a collector, and an energy barrier, said energy barrier between said metal base and said collector to block thermalized carriers in said metal base, said collector having a quantum well for facilitating light emission.

Kamiguchi does not teach or suggest a metal base hot carrier transistor with an energy barrier between the metal base and said collector to block thermalized carriers. Kamiguchi has no metal base. Kamiguchi also requires diffusive and drift current flow, not hot electron flow over an energy barrier. His diffusive and drift current flow requires the opposite of an energy barrier. Current flow would be cut off with his drift and diffusion device were there an energy barrier. In addition, Kamiguchi does not teach or suggest a collector having a quantum well for facilitating light emission. Therefore the rejection of claim 39 and claims dependent thereon as anticipated by Kamiguchi under 35 U.S.C. § 102(b) has been traversed.

Claim Rejections--35 U.S.C. § 103(a)

The Examiner rejects claims 1-8, 10-20, 31-32, 39-41, 43, and 48 under 35 U.S.C. § 103(a), as being unpatentable over Nurmikko in view of Sato '143. First, Sato teaches a three terminal device and Nurmikko provides a two terminal device. Further invention would be needed to provide the three terminal device teachings of Sato into the two terminal device of Nurmikko. It would not be obvious to one of ordinary skill how to combine their distinct teachings.

Applicant would respectfully ask the Examiner to consider that while Sato teaches a hot electron spin valve transistor that is a single device, he does not teach or suggest light emission. Sato's device provides electron flow into an n type collector. Thus, there

is no recombination and no light emission in Sato. Nurmikko has light emission but not with hot carriers, as provided in claims 1 and 39. Neither reference, individually or in combination, teaches or suggests the limits of claim 1 or claim 39. To provide hot carriers a barrier would be needed, and providing a barrier would defeat the diffusion and drift current flow of Nurmikko.

Applicant has reviewed the Van De Berg and Epstein references. These reference are no more relevant than the prior art relied upon.

It is believed that the claims are in condition for allowance. Therefore, applicant respectfully requests favorable reconsideration. If there are any questions please call applicant's agent at 802 864-1575.

Respectfully submitted,
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